DEVELOPING
IE DAMODAR VALLEY

THE PUBLICATIONS DIVISION
MINISTRY OF INFORMATION & BROADCASTING
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CONTENTS

CHAPTER I

THE RIVER AND THE VALLEY

The river Damodar rises in the Chhota Nagpur hills It is a monsoon fed river Its source is to be found in two streams which after flowing for 26 miles meet just within the western boundary of the district of Hazaribagh in Bihar Henceforward the united stream flows eastwards for 93 miles in the same district and then passes into the next district Manbhum where it receives its chief tributary the Barakar from the north Lower down now in the Burdwan district of Bengal it becomes navigable during the rains and assumes the dignity of an important river It turns to the south ea t and a little beyond the town of Burdwan takes a sharp turn to the right and flows south through the rest of the district and through the Hooghly district Before entering the river Hooghly however it becomes near Salimabad in Burdwan a deltaic river and instead of receiving tributaries starts throwing off distributaries Of these the Begua is a well defined river while the Kana Damodar as the name signifies is at present a dead stream The Begua joins the Roopnarain while the Damodar proper falls into the Hooghly some 30 miles below Calcutta

The gradient or the degree of slope which the river exhibits at different points of its course is an interesting study In the Hazaribagh district for instance at the point where the two streams meet the elevation of the river bed is 1 326 feet above mean sea level At Ramgarh after a distance of 38 miles the bed level comes down to 1 003 feet and near Bermo railway station where it receives the Bokaro its bed is 713 feet Thus far the average fall of the river is only 9 feet per mile while if we take its full length of 93 miles its fall averages 8 feet per mile — a total of 744 feet — and it leaves the district with an elevation of 582 feet to be distributed over its remaining course of nearly 250 miles As it proceeds gradient gradually diminishes and near its confluence the elevation of the valley floor is 330 feet

its confluence with the Hooghly the average fall is only about a foot per mile In other words in the earlier part of its course through Bihar it has a rapid flow and brings down large quantities of silt as it enters Bengal where the flow becomes sluggish

Unlike the Ganges or the Jumna the Damodar as already mentioned is a monsoon fed and not a snow fed river and therefore its flow is not perennial During the dry months the river has very little water and in the upper reaches none at all its bed being covered with dry coarse sand Near the Anderson Weir in Burdwan the average flow in the dry months is 200 to 300 cusecs But when the rains come the tiny stream swells and flows with the fury of a hill stream the average flow being about 30 000 cubic ft per second in the vicinity of the Anderson Weir The maximum flow so far recorded in this century is 650 000 cubic ft per second and it was registered thrice during the great floods of 1913 1935 and 1941

The upper Damodar that is the river above its confluence with the Barakar drains 6 960 sq miles the middle Damodar comprising the section below this and up to Raniganj drains 500 sq miles while the lower Damodar from Raniganj down to its confluence with the Hooghly drains 1 000 sq miles The river Barakar drains another 2 690 sq miles If there is heavy rainfall in the catchment areas of the upper Damodar and the Barakar the chances of floods occurring in the lower basin increase

The population in the entire valley would be about 5 millions of which less than half live in the upper Damodar valley in the districts of Hazaribagh Palamau Ranchi Manbhum and the Santal Parganas in Bihar The average density of population in the middle and the lower Damodar valley both in West Bengal is double that of the upper valley The chief towns in the upper valley are Giridih and Hazaribagh each with a population of about 25 000 It is a plateau intersected by deep ravines and extensive valleys The highest point in this hilly area is Parasnath (4 480 ft) which attracts thousands of pilgrims every year on account of its Jain temple The largest towns in the middle and the lower valley are Asansol and Raniganj with a population of 56 000 and 23 000 respectively

The hills of the upper valley have been denuded of their vegeta tion by thoughtless felling of trees Consequently the region has been badly eroded and cut up by deep gullies The rich top soil in this fertile region is thus washed away periodically by the Damodar In some places the land has been terraced for cultivation but the crops can be raised only in the monsoon months and if the monsoon does not arrive in time the crop is completely ruined In the tracts where forests still survive the chief products are timber lac tussore silk and *mahua* flowers which are used both for food and for distillation into strong country liquor

This valley is the home of several Adivasi tribes chief among whom are the Oraons the Hos the Santals and the Mundas They have made the land in this hilly country cultivable after generations of hard labour by clearing and terracing land by damming of streams For centuries too they have retained their distinct tribal organization culture relig on and language The development of the valley will bestow considerable benefit on these tribal people

The middle and the lower valley receives layers of alluvial soil from the flood waters The soil is most fertile although in the absence of proper irrigation intensive cultivation is not possible The main crop is Aman paddy which is sown towards the end of June and the crop depends for its growth on an abundant supply of water during the next few months It has been estimated that the failure of corps for want of water occurs on an average once in three years With adequate irrigation and assured water supply throughout the year such failures will b a thing of the past indeed it may even be possible to grow additional crops of vegetables or grains during the winter season It is clear that the very existence of the agricul tural population in these parts is linked with the river

While agriculture is important in the middle and the lower valley the major importance of the entire valley lies elsewhere It is the richest zone for minerals in India and the chief source of her industrial wealth There is both variety and richness in its mineral resources The most important coalfields of the country to be found here Those of Jharia Raniganj Bokaro k

Rangpur and others between them account for 80% of India s total annual production of coal In and around the valley are concentrated the rich iron ore deposits of the country Large reserves of bauxite and aluminium laterite are centred in the Palamau and Ranchi districts Other important minerals are fire clay china clay mica limestone copper kyanite chromite lead silver antimony steatite molybdenite and quartz With cheap electric power the valley is therefore capable of a very high standard of indu trial development

Some very important industries based on the deposits of coal and the local supply of other raw materials have already grown up in the valley The iron and steel works of the Indian Iron and Steel Co Ltd at Kulti and at Burnpur the Assoc ated Cement Company s works at Khelari the Kumardhubi Engineering Works and *Fire Brick and Silica Works* the Bengal Paper *Mills* and *Pottery Works* at Raniganj the Chemical Fertiliser Plant at Sindri and the Coal Carbo nisation Plant are some of the industries which have been established in this valley There are besides a numb r of thermal power stations supplying power to the collieries industrial establishments radio workshops etc*

There is a network of railways and roads connecting the valley with upper India The Grand Trunk Road starts from Howrah traverses the valley at Asansol and proceeds westwards crossing the valley near the headwaters of the Barakar river The Grand Chord Line goes up the valley to Gomoh a branch line passes through Bokaro and the Konar coal fields and joins the Grand Chord Line again a Sone Fast Bank *via* Daltonganj The railway station at Tori near the headwaters of the Damodar is on this line

Notwithstanding its rich agricultural and mineral possibilities the people of the valley are poor A *potentially* rich and happy region thus presents today a picture of starvation misery and ruin The river that should have been a river of plenty has so far been a river of sorrow — sorrow brought about by lack of irrigation by soil erosion and catastrophic floods

CHAPTER II

THE PROBLEM

Normally the silt and sand carried by a river are deposited near its mouth Its transporting power increases considerably during the rains when the water flows at greater speed If the banks are flooded part of the silt is deposited on them the excess load is left on the river bed raising both the bed and the banks as time passes This is a feature which is common to all rivers Every river carries silt more or less but in the case of the Damodar the quantity of silt carried is enormous The rain water from the catchment area higher up the river rushes down into the Damodar and its tributaries If this were covered with trees there would be little erosion of the soil and the speed and volume of the water swelling the river correspondingly less

Trees have an important function in nature s economy Besides catching water they make the land moist and fertile let part of the water go underground and thereby diminish its volume and rush after the rains The unplanned felling of trees in the hills which form the upper catchment area of the Damodar and its tributaries has greatly contributed to soil erosion in the upper Damodar Valley which lies in Bihar Indirectly it has also contributed to the choking of many old channels by depositing silt

It must not however be imagined that deforestation is the sole or main cause of floods in the lower Damodar Valley The main cause of the devastating floods is of course the short period of intense rainfall which is beyond the capacity of the Damodar river to carry The average annual rainfall in this region for instance is about 50 inches In recent times the maximum record was 64 odd inches and the minimum about 30 inches The upper Damodar however gets about 90 per cent of it during the monsoon months although as a rule there can be no flood in the upper reaches owing to the hilly nature of the country and to the fact that the valley being deep is able to accommodate the extra water But in the lower reaches where the valley is shallow

and land practically flat the stream loses its velocity depo its the silt and on occasions overflows the banks and floods the countryside

Clearly the problem that the Damodar has created for Bihar is of soil erosion and lack of water in the dry months and for Bengal of the danger of flood during the monsoon months None the less while the evil effect of soil erosion is felt every year and grows worse from year to year it is not so sudden and spectacular and catastrophic as the floods Floods ruin people overnight and cause over whelming destruction of life and wealth in a surprisingly short space of time In 1770 for instance a flood almost totally destroyed the town of Burdwan ruined the whole line of embankment and caused a severe local famine In 1823 and 1855 again floods swept away whole villages on the banks of the river In this connection a Calcutta monthly wrote the following in 1823 Picture to yourself a flat country completely under water running with a force apparently irresistible and carrying with it dead bodies roofs of houses palanquins and wreck of every description The flood lasted for three days the landmarks of peasant holdings were washed away and bankruptcy and litigation followed In the present century besides some minor ones there have up till now been as many as four catastrophic floods in 1913 1919 1935 and 1943 bringing death destruction and ruin in their train in the part of Bengal below Raniganj which forms the lower Damodar Valley The destruction caused by the floods in 1943 is still fresh in public memory It led to the stoppage of all traffic between the railway stations above and below Burdwan from July to October The East Indian Railway had therefore to divert traffic along a circuitous route and this diversion alone cost the railways more than Rs 53 lakh while the cost of repairing roads railway lines culverts and bridges was several times this amount The countryside below Burdwan was submerged to a depth of 6 to 7 ft and many villages were washed away Indeed Calcutta itself would have been flooded and Burdwan destroyed had the breach in the left bank occurred lower down.

These floods have been known to work another kind of damage also As an eminent scientist has put it besides the temporary flooding of the rice fields and the destruction of villages

the floods have been known to cause enormous damage by forcing the river to cut new courses through populous localities In fact an examination of old records and of the topography of the country shows that the lower course has shifted fan wise with Burdwan as the apex and the point where it falls on the Hooghly (Bhagirathi) has shifted from the vicinity of Katwa 100 miles to the north of Calcutta to the Roop narain river nearly 40 miles to the south of Calcutta All these changes in course can be traced to catastrophic floods occurring in past centuries

The Government of West Bengal made an attempt in recent years to assess the loss caused by the Damodar flood of 1943 Apart from the loss of human lives and livestock it has been estimated at Rs 7 96 00 000 in current prices This gives an idea of the magnitude of the damage caused by floods in the lower Damoda Valley It has been responsible for the deterioration of large and prosperous tracts in West Bengal

In fact even in the last century it was felt imperative to remove this menace and no cost should be counted too heavy for the provision of security for the people living in this area against periodic visitations of catastrophic floods

In the past protection was sought for the area in the middle and the lower valley the principal victim of floods by digging overflow canals and by building embankments This however proved in adequate as a safeguard against floods The accumulating silt choked up the channels and embankm nts were raised both on the left and right banks but those on the right were removed in 1838 The land on that bank was given over to flood spill for it wa believed that the higher elevation and the rocky undulating surface of the land on the right bank would make it less open to danger Gradually how ever the ground level on the right bank has risen to about 8 ft. above the ground level on the left Meanwhile the silt which could not escape settled down and raised the level of the river bed itself The result is that while the safety valve on the right has not worked satisfactorily the embankments on the left are under increasingly heavy pressure. On the other hand the people protected by the embankments suffer from ill health while their land does not receive its share of the rich silt carried by the floods

Breaches occurred in the embankments in 1888 1913 1935 1940 and 1943 Gradually, it has therefore come to be recognised that if this state of affairs continues Calcutta whose level is lower than that of the surrounding country is faced with grave danger Indeed, the carrying capacity of the Hooghly has been diminished so much that if the Damodar cuts a channel to the east through the left bank and a serious flood occurs the extra volume of water cannot be carried away by the Hooghly and the rushing waters are bound to sweep over the city and the industrial area on both sides of the river What indeed makes the situation alarming is the fact that the Damodar is already being forced eastward.

While the building of embankments had been no solution a satisfactory remedy was suggested by the Glass and Adams Williams Report This was the result of an investigation which lasted eight years from 1913 to 1920 It proposed a number of reservoir dams to control floods and to convert the Damodar from a seasonal into a perennial river At the same time by providing extensive irrigation this would have enabled the peasantry in the lower basin to raise two or three crops in their fields Calcutta would also have been freed from the constant menace of floods The scheme was however dropped

In 1943 again in the midst of another devastating flood the Bengal Government set up the Damodar Flood Enquiry Committee The Damodar Valley Project was the concrete result of its report The Committee suggested that the problems of the Domodar Valley should be solved in the same way as the Government of the United States had done with those of the Tennessee Valley in 1933 This suggestion was examined by the Central Technical Power Board and in August 1945 was considered and adopted at a joint meeting of the representatives of the Central Government and the Provincial Governments of Bihar and Bengal But it took another three years to set up a corporation on the model of the Tennessee Valley Authority to undertake the execution of the Damodar Valley Project Thus in July 1948 the Damodar Valley Corporation was brought into being by Central legislation It is important to remember that this took place about a year after India had become an independent country

CHAPTER III

AN AMAZING PROJECT'

It has already been observed that the problem of th Damodar is that it runs too fast and runs to waste and that, too only for a part of the year If you could make it walk all the year round and not let it run for a few months there would be no problem left Indeed it would provide more than a solution many other benefits would follow If for instance you could cover the catchment areas with suitable vegetation it would absorb a part of the rain water and reduce *its run off This would mean more water for the land* If again you could arrest the flow of the water in the river itself hold and make its accumulated volume stand in a reservoir and then let it out slowly in adequate quantities keeping a continuous flow along its bed throughout its career there would be no flood and all the benefits that a perennial river can give to a country would accrue to the people living in the area If in addition you could cut canals along and away from the banks to irrigate the fields in the countryside the peasantry would get water for their fields all the year round and be able to till many more acres than they do now In fact the exceptional fertility of the soil makes it possible to grow as many as three crops in the year instead of an uncertain and unsatisfactory one as at present The standing water or the reservoir as it is called could be put to yet another use The water for instance could be made to work turbines to generate electricity at very low cost without any wastage of water The electricity thus produced would be very cheap and could be extensively used both for domestic and industrial purposes Eventually it may even be possibe to run the railways by cheap power The object of the Damodar Valley Project is essentially to effect a co-ordinated development of the resources of this potentially rich valley Its main work is to construct a number of dams on suitable sites in order to control floods let out water through sluices for perennial flow and generate power by means of water turbines The project also envisages an extensive digging of canals both for navigation and irrigation and for transport

and agriculture That is why it is known as a multi purpose project In the words of the former Chairman of the DVC Mr S N Mozumdar the Damodar Valley Corporation Act aims at irrigation water supply drainage generation transmission and distribution of electrical energy flood control in the Damodar its tributaries and the channels improvement of flood conditions in the river Hooghly navigation in the Damodar its tributaries and channels afforestation control of erosion promotion of public health and agricultural industrial economic and general well being in the valley and the Corporation s area of operation which is outside the valley

It is indeed, an amazing project as the Engineering Adviser to the World Bank Gen R A Wheeler remarked when he came on a two-day visit to the Damodar Valley As a matter of fact the Damodar Valley Corporation goes farther than the Tennessee Valley inasmuch as the Damodar Valley Project has all the basic objectives of the latter and more The TVA provides no irrigation facilities while it is one of the most important items among the benefits the DVC seeks to confer on the people

In specific terms the DVC is mainly entrusted with the construction of the following

(1) Eight dams on the Damodar and its tributaries and hydro electric stations in each of them with a total installed capacity of 240 000 kw. The total reservoir capacity of the dams as designed would be 4 7 million acre feet. This is estimated to be sufficient to protect the valley from the design flood of one million cusecs the highest flood hitherto recorded being 650 000 cusecs

(2) A Thermal Power Station at Bokaro near the confluence of the Bokaro and the Konar rivers This will use low grade coal from a nearby coal field and will have an ultimate installed capacity of 200 000 kw

(3) A Power Transmission Grid covering 375 miles of 132 KV primary lines with necessary lengths of 66 KV and 33 KV secondary lines

(4) A barrage at Durgapur about 15 miles below Raniganj and 27 miles below Asansol to divert the regulated flow from the upper

reservoirs for irrigatian and navigation There will be a network of irrigation canals and distributaries totalling 1 563 miles which will include an irrigation cum navigation canal 85 miles long joining the river Hooghly 35 miles above Calcutta In addition there are other schemes relating to soil con ervation the rehabilit tion of people displaced by the ubmergence of villages by the reservoir water malaria control minerological and industrial survey agricultural and fisheries develop ment and recreation facilities

In selecting the dam sites various considerations had to be taken into account one of the most important being that the uncon trolled area below the dams should not be of such a size as could produce a flood greater than the one controlled in the upper reaches of the stream in ca e the maximum storm rainfall were to be centred over the uncontrolled area In fact the topography of the Damodar Valley is such that it is not possible to locate any dam which would pr ovide substantial storage capacity below the confluence of the Barakar and the Damodar The drainage area immediately above this confluence is roughly triangular and therefore conducive to higher rates of flood if the storm rainfall were to be centred over this area To obtain the maximum benefit from flood control it is necessary to locate the control dam as far downstream of both the Damodar and the Barakar as is permitted by topography The choice of th dam sites at Maithon on the Barakar and near Panchet Hill on the Damodar each only a few miles above the confluence of the two rivers was dictated by this consideration These two reservoirs however do not provide sufficient storage capacity for the comb ned require ments of flood control and the regulation of minimum flow The construction of a few other reservoirs upstr am was therefore felt to be necessary and sites were selected accordingly They are at Balpahari and Tilaiya on the Barakar and at Aiyar on the Damodar Sites for two other dams were also selected one across the Konar and the other across the Bokaro

All this will of course take time to execute and the develop-ment plan will therefore have to be worked out in different phases It was therefore decided to complete four dams with hydro-electric plant in the first phase lasting 8 years from July 1948 to June 1956 There would be one at Tilaiya on the upper Barakar another at

Maithon on the lower Barakar a little above its confluence with the Damodar a third at Konar on the Konar river and a fourth at Panchet Hill on the main Damodar Included in the first phase are the barrage at Durgapur with the irrigation cum navigation canal and its distributaries the Thermal Power Station at Bokaro the Power Transmission System and finally soil conservation rehabilitation and agricultural development

The Tilaiya dam was proposed to be an all concrete gravity type dam with a height of 112 feet from the foundation to the roadway level and to have a total length of 1 147 ft The work has already been completed according to schedule and even before the onset of the monsoon in 1953 it had impounded water to form a lake with a surface area of more than 20 sq miles Its total impoundage will be 320 000 acre feet The water of this reservoir is expected ultimately to irrigate 99 000 acres of land (*kharif* — 24 000 acres and *rabi* — 75 000 acres) The proposed hydro electric station has also been completed and two units of 2 000 kw each installed while there is also room for a third unit of the same capacity

The Konar dam is to be a concrete cum earth dam on the Konar The concrete section is to be built across the bed of the river and the earth dams on the two sides the total length being 12 959 ft From the lowest foundation to the roadway the dam will be 196 ft high Its total impoundage will be 260 000 acre feet The site has been selected in order to take full advantage of a steep gradient of 440 ft which will be utilised for the installation of an underground hydro electric station of 40 000 kw while the tail race water will be discharged by a tunnel into the lower reaches of the river One purpose of the dam is to supply cooling water to the Thermal Power Station at Bokaro another to supply *kharif* irrigation for 36 000 acres and *rabi* irrigation for 68 000 acres The dam is expected to be finally completed in March 1954 though partial storage was arranged during the 1953 monsoon

At Maithon across the lower Barakar an earth dam is being built with a concrete spillway 622 ft long on the right bank of the river the length of the whole dam being 11 940 ft The height of the dam from the river bed to the road level would be 162 feet The

dam will impound 1 104 000 acre feet of water and ultimately have an underground hydro electric station of 60 000 kw capacity It is scheduled to be completed by October 1954

The design and the size of the Panchet Hill dam are roughly similar to that at Maithon It will store 1 214 million acre feet of water and its hydro electric station will have an installed capacity of 40 000 kw Like the Maithon dam its main purpose would be flood control It is expected to be completed by the end of 1955

The Thermal Power Station at Bokaro was proposed to be built mainly for one reason namely that in the nature of things the generation of hydro electric power would vary with the water supply As the Damodar and its tributaries are monsoon fed most of their waters as already mentioned come down in three to four months Thus even after the dams have been built and a perennial flow established only a third of the power would be available throughout the year The other two thirds will therefore remain seasonal and available only during the monsoon months Hence the necessity of a steam power station to keep the supply of electricity stable throughout the year The easiest way to firm up the seasonal hydro power is to set up a power station using coal Luckily the Damodar Valley is also a coal area and it was decided to utilise the low grade high ash coal of the Bermo coal field from which Bokaro is only six miles away The installed capacity of this Thermal Station will eventually be 200 000 kw consisting of 4 units of 50 000 kw each One unit had already been installed by February 1953 two others were being erected and expected to be ready by the end of 1953 The station is already generating electricity

The Power Transmission Grid will consist of 375 miles of 132 KV double circuit transmission lines with necessary lengths of 66 KV and 33 KV secondary lines as well as adequate sub stations and sub transmission lines capable of serving an area of about 25 000 sq miles and supplying 526 000 000 KWH of electrical energy per annum The total route mileage of the transmission lines will come to more than 500 Besides transmitting power to towns and industrial establishments it is expected that the railway between Calcutta and Mughal Sarai

will run on electricity to be suppli d by the DVC power stations and transmitted through the DVC grid

The proposed barrage at Durgapur across the Damodar will receive water from the four storage dams above and distribute water for irrigation through the irrigation canals and their distributaries The area to be irrigated will co er 1 025 762 acres for *kharif* and 300 000 acres for *rabi* cultivation The barrage is expected to be completed by June 955 and the entire ork of the navigat on cum irrigation canals and the distributaries with a total length of 1 563 miles by June 1957 The supply of water for irrigation through the existing canals will ho vever commence earlier

In passing it may be interesting to observe that when the work on TVA first started there was no dearth of qualified engineers in America to work out the project In the case of the DVC however experienced technical personnel were almost entirely lacking at the beginning On the other hand it must also be remembered that the TVA started functioning in the worst period of depre sion and deflation in American economic history Apart from the benefits that the project could bring in the future such an adventure was a real immediate boon to the people When the DVC came on the scene in 1948 the time was unhelpful in many ways In the post war years there were—and they still continue—shortages all round of rupees foreign exchange plant and equipment and of technical men Unlike the TVA the DVC had to buy everything from a sellers market TVA could draw its equipment practically ex stock from across the Mason Dixon line suppliers were only too anxious to sell The DVC had to obtain the plant and equipment from across half the world and the deliveries took too long and the price were sky high

Undaunted by these handicaps and ob tacles the leaders of the first Government of independent India undertook this mighty venture and this major development project was soon under way

CHAPTER IV

NATURE'S PRIORITY

In natural resources and economic potentialities the Damodar region is easily the richest in India and one of the richest in the world. It is the coal valley of India with iron ore deposits nearby. The pace of future industrial progress of this country will thus be very largely determined by the activities in this region since it is also the home of the Indian metallurgical industry with iron and steel plants in Jamshedpur, Kulti and Burnpur. It is indeed a natural location for a number of heavy industries based on steel and coal.

The first phase of power development in this area is due to be completed by June 1957 and the total installed capacity of power will be 294,000 kw of which 144,000 kw will be hydro and 150,000 kw thermal power. In addition 22,500 kw of thermal power will be supplied by the Sindri Fertiliser Factory for transmission by the Damodar Valley Corporation Grid System.

There is a large and ready market for power in this region. This is capable of rapid expansion and is likely to expand quickly so as to absorb all the power produced by these plants.

The development of this valley is also important for another reason. As the defence potential of a nation depends on its key industries — coal, iron and steel, aluminium, chemicals, the transport system, etc. — the development of the Damodar Valley will be vital to national defence.

In the upper valley power will be the main product of the Damodar Project, in the lower food and other crops. Like the Nile Valley the lower Damodar basin is one of the most fertile regions for agriculture. At present owing to lack of irrigation facilities and uneven distribution of water in different parts of the year the cultivators cannot raise more than one crop. Moreover the existing canal system can irrigate only about 185,000 acres in the *kharif* season. Over the rest of the area the output per acre is very low. Rice is the main crop grown

and after it is harvested almost the entire land lies idle Winter crops are grown on about six per cent of the cultivated area With an assured supply of 10 to 12 inches of water these lands will easily yield a second crop

When the first phase of the project is completed there will be plenty of irrigation all through the year and land will yield three crops instead of one and the irrigated area will go up to 1 025 767 acres instead of the existing 18 000 acres Only then will it be possible to take full advantage of the fertility of the region Indeed it is likely to become the granary for Calcutta and the surrounding industrial areas for which food is now imported from outside West Bengal Agriculture will be diversified and with Calcutta the largest urban market of India next door the farmer will be in a position to obtain a higher income from the land

Water is scarce in the valley in the dry months It will now be available even during the execution of the first phase When the project is completed not only the town villages and coal mining areas will have water in adequate quantities but also some of the industries

The navigation channel connecting this area with Calcutta will contribute greatly to the relief of traffic congestion The supply of an adequate number of wagons for the transport of coal easily and cheaply to Calcutta has been a constant source of anxiety for the railway authorities It has been assessed that The annual traffic (along the navigation channel) should grow from 1 million tons in 1954 to 2 million tons in five years Indeed as the valley develops with the completion of the project the volume of freight is bound to increase Cheap transport will itself stimulate industrial growth

Another important benefit to accrue from the project will be the eradication of malaria This region which at one time was a flourishing and healthy area became a hot bed of malaria when its natural drainage was upset by the building of railways Malaria control has thus been one of the important activities of the Corporation and the project will make a major contribution to the welfare of the people

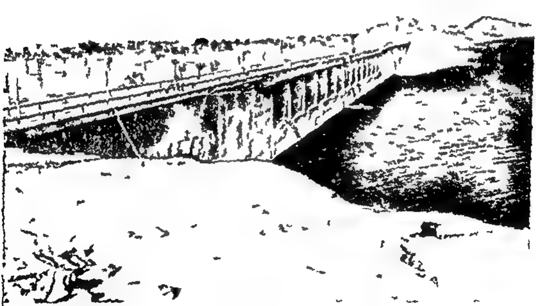
In course of time the valley will also become an important tourist centre The scenic beauty of its hills its bracing climate and its lakes

Haystack being built by Adivasi villagers

Adivasi shepherd boy

Oraon tribesman from the Chhota Nagpur Hills

Site for Tilaiya Dam before construction



Tilaiya Dam

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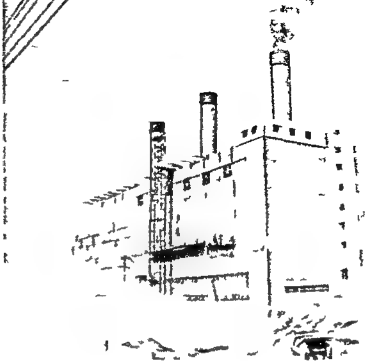

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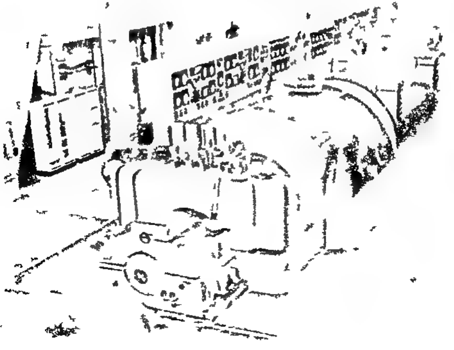
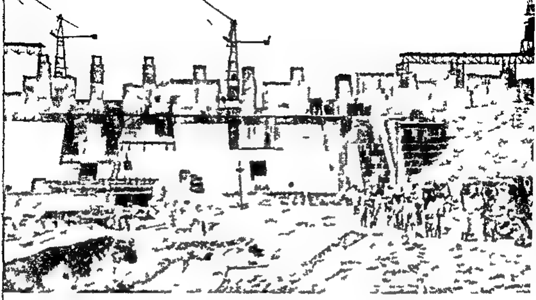
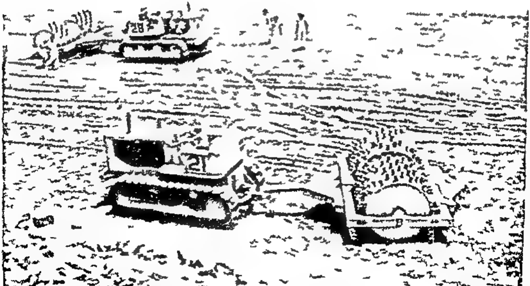
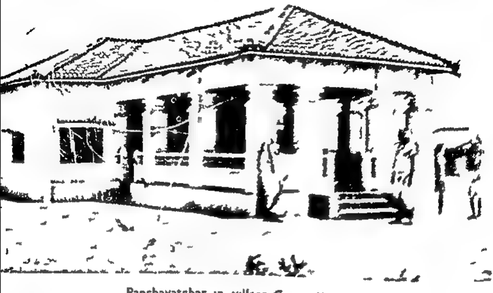




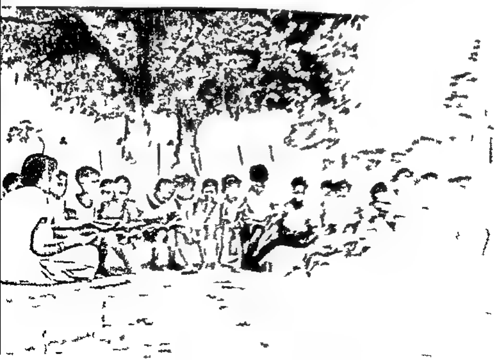
Cement concreting at Konar





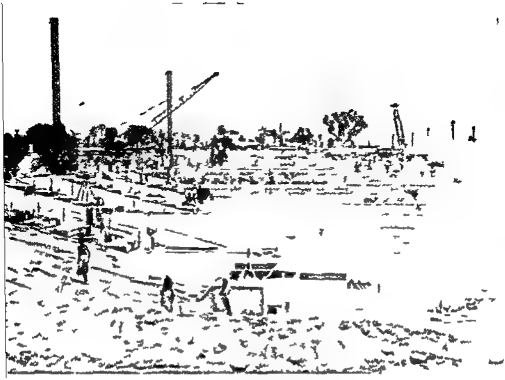
Panchayatghar in village Gauria [illegible]

Open air school for displaced children from Tir [illegible]

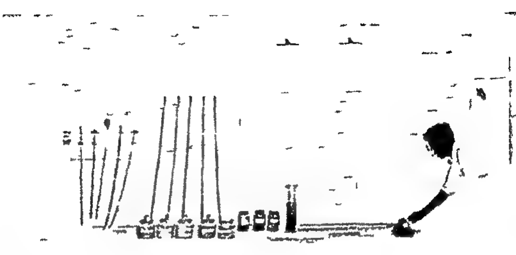


Village with vast stretches of cultivable land (foreground) lying unused for want of irrigation facilities

Village with flourishing fields of Chinese paddy

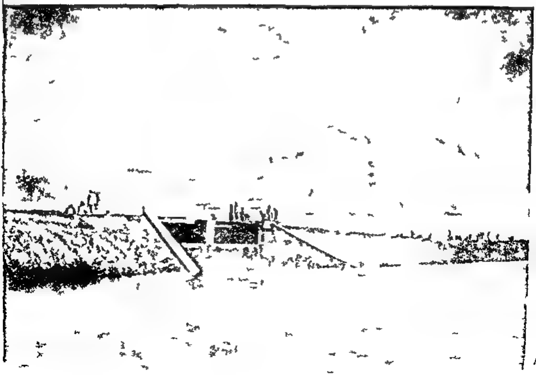


Construction work at Durgapur Barrage
Chharwa Headwater Dam Hazaribagh



Soil Engineering Laboratory Maithon

Gauria Karma Dam and Reservoir



and forests — a result of the project itself — will attract many in search of health and recreation

Why is the Damodar Valley Project so important? It is often said that large river valley projects take time before they can yield results and that short term projects are far less costly and bring benefits sooner. It should be noted that from this point of view also the Damodar Project has a claim to prior consideration. It is in reality a combination of a number of short term projects and people will not have to wait long for benefits. In fact more power and water are already available

It is therefore not surprising that the Damodar Valley was selected for a multi purpose development project. It is indeed a case of nature's priority

COSTS AND BENEFITS

The cost of the Damodar Project as first outlined by Mr Voorduin in 1945 was estimated at Rs 55 crore In this connection Mr Voorduin himself made the following observation It should be noted that the basis of estimating is extremely rough and can serve no other purpose than that of obtaining an approximation of the magnitude of the capital expenditures required More accurate estimates can be obtained only after completion of the necessary field investigations Indeed accuracy of estimates cannot be guaranteed without elaborate investigations involving time and expense Nevertheless Mr Voorduin s estimates came very near the mark for it must be remembered that they were made just after the war when the steep rise in the general price level in subsequent years could not be anticipated The scheme drawn up by Mr Voorduin was later divided into two phases of which the first phase was the more important and costly Of the estimated total of Rs 55 crore Rs 37 81 crore were earmarked for the first phase while Rs 17 19 crore were to be spent in the second phase

Detailed estimates for the first phase were made early in 1951 and the cost went up to Rs 74 98 crore that is about twice as high as the rough preliminary estimates of Mr Voorduin This rise is accounted for not only by the steep rise in prices since 1945 and by the effects of the devaluation of the rupee but also because the scope of the project itself had been expanded beyond what Mr Voorduin had proposed in his Unified Development of the Damodar River Th additional items now included are (1) The navigation canal at Durgapur estimated to cost Rs 2 266 crore (2) Over and above one hydro power station at Konar with an installed capacity of 0 000 kw two more power stations with installed capacities of 6 700 and 10 000 kw respectively It was also decided to combine all the three power stations at Konar into one single high head underground station to be constructed just below the Konar dam The installed capacity

was also increased to 40 000 kw This increased the expenditure by Rs 3 53 crore (3) The size and capacity of the transmission system have also been increased threefold thereby raising the expenditure by Rs 3 33 crore Along with the extension of the programme for development of power it became necessary to expand the capacity of the transmission system so that the power might have a ready market The size and capacity of the transmission lines have thus been increased from 150 miles of 132 KV to 510 miles of which 375 miles will be 132 KV with additional sub stations (4) The additional irrigable area in the lower valley was also increased from 575 000 acres according to Mr Voorduin s estimate to 840 762 acres This increase by 46 per cent necessitated an extra capital cost of Rs 5 2 crore (5) The Thermal Power Station as recommended by Mr Voorduin had a capacity of 150 000 kw only while the present power station at Bokaro has been designed for an ultimate capacity of 200 000 kw To make it accessible 22 miles of roads had also to be constructed All this naturally raised the cost (6) The plan for the resettlement of the displaced families from the reservoir areas and the programme for malaria control have greatly incr ased the cost

The devaluation of the rupee announced in September 1949 added to the rupee cost of the orders placed in the USA Indeed devaluation directly raised the co t by about Rs 3 9 crore The cost of construction work has al o been doubled since 1945 Thus the estimated cost of the project in the first phase went up to a little less than Rs 75 crore That is to say the estimated cost of the programme undertaken by the DVC has gone up by 42 per cent owing to the expansion of the scope of the programme 10 per cent from devalua tion and 47 per cent on account of the general rise in prices The project is being financed by the Central and the Bihar and West Bengal Governments

It is not to be concluded however that in the revised estimates the planners and the executors have not thought of economy In fact by simplifying considerably the design of the two flood control dams at Maithon and Panchet Hill the revised estimates have actually been reduced to some extent

In short the project now costs more because among other things the scope of the original project has been considerably enlarged If

plants equipment etc cost more now the benefits calculated in terms of current prices have also gone up proportionately It may not of course be difficult to calculate the benefits roughly in terms of money but it must not be forgotten that the DVC is not primarily a commercial proposition It is essentially a measure against the occurrence of floods Next in importance comes the agricultural and industrial development of the valley The earning of commercial revenue although not a primary objective will by no means be a negligible item in the balance sheet of the DVC

It has been calculated that the gross annual revenue and the working expenditure of the DVC when the first phase is completed will amount to Rs 6 01 crore and Rs 2 1 crore respectively leaving a net annual revenue of Rs 3 9 crore If the total capital cost incurred in the first phase comes even to Rs 85 crore it would not be a bad investment for a net annual revenue of about Rs 4 crore will have been earned thereby If this is the direct financial return of the invested capital the amount of additional wealth that will be created is equally impressive With the completion of the first phase the estimated additional wealth will be about 56 *lakh maunds* of rice 36 *lakh* maunds of winter crops 1 790 000 maunds of paddy straw 94 90 00 000 kwh of power (not including power from Sindri) If we add to these figures the amount that would have been lost by damage to crops through floods the accruing benefits as estimated in terms of their gross money value would come to about Rs 30 crore per year at current prices

CHAPTER VI

IMPLEMENTATION OF THE PROJECT

Although the Damodar Valley Corporation was set up in July 1948 it has had to face many difficulties before it could launch the project The preparation of estimates involved a considerable expenditure of time A great deal of preliminary surveys investigations including foundation exploration and planning had to be carried out before the design could be undertaken The production of the drawings also meant labour as well as time and it was only after the designs had been completed that the costs could be estimated Even then there was no certainty that the designs and estimates would be final for they might have had to be altered as construction went on

As the Damodar Project is made up of several individual schemes the whole process of survey investigation planning designing and the preparation of estimates had to be carried out repeatedly before a cost estimate for the whole scheme could be drawn up

Tilaiya

The site of the Tilaiya dam is on the Barakar 130 miles above its confluence with the Damodar and 14 miles from Kodarma railway station The adjacent hills on either side make it a natural site for the construction of a cement concrete gravity dam economically

The dam has been designed and built departmentally Preliminary work including the construction of camps began early and excavation started in October 1949 Hundreds of unskilled labourers were employed on the river bed and the work was done in the traditional head basket style Naturally progress was slow The first bucket of concrete was poured in November 1950 and in the initial stages the volume of concrete poured reached only 50 cubic yards a day From January 1951 however the pace quickened when it was decided to expedite the work as far as possible with modern mechanised method As the process of mechanisation increased the daily output went up from 50 to 400 cubic yards and by November

1951 when the work had been fully mechanised the output rose to 500 cubic yards a day Thus by August 1952 out of a total of 148 000 120 000 cubic yards of concrete had already been placed Indeed the river gap up to the river bed level was filled ju t a day before the monsoon started in 1951 thereby obviating the need to put up additional coffer dams to enable construction to continue after the onset of the monsoon By June 1952 the entire dam had been constructed to well above the river bed with the exception of three blocks which could not be constructed owing to a late delivery of steel penstocks or pipes through which water is directed for the generation of power As a result the penstock blocks upstream could not be completed before the monsoon for fear of floods The penstocks were however delivered and installed in May When the flow of water was low at the beginning of July the con truction superintendent built up a temporary earth coffer dam before the three blocks and started concreting The risk however was justified and the raising of the concrete just kept ahead of the rise in the reservoir level Gradually temporary high level sluiceways were made and their openings closed as the height of the concrete dam was raised

Thus on July 4 1952 the gaps were finally sealed and the Tilaiya dam began to store water and its level rose In fact by the end of October the water in the reservoir was 70 ft deep and had spread over more than 20 square miles The hydro electric station has also been completed and two units each of 2 000 kw have been installed while space has been reserved for the installation of a third unit

Thus the Tilaiya dam was completed according to schedule and the water stored for use in the dry season of 1952 53 On February 21 1953 it was formally opened by the Prime Minister It may incidentally be mentioned that this dam is the first all concrete dam in India and it has been built entirely by Indians

Anybody who has visited this area during the summer of 1953 must have noticed a thin river coursing down Tilaiya for 128 miles right up to the Damodar while previously at that time of the year the river bed used to be dry and full of coarse sand From the dry season of 1952 53 the people on both sides of the river have started drawing

water from it for drinking and other purposes — a benefit they had not enjoyed for hundreds of years Formerly they used to get their water only from July to October and for about eight months there was no water in the river Now the water famine has been removed Water can be had for irrigation also but it will have to be mostly lift irrigation It has been calculated that with the completion of arrangements for lift irrigation the water in the reservoir should in due course be able to give *kharif* irrigation to 24 000 acres and *rabi* irrigation to 75 000 acres Meanwhile for the development of fisheries 400 000 fingerlings have been released in the lake Electricity is already being generated in the hydro electric station and distributed to Kodarma and Hazaribagh for lighting and power through the Bihar Government Flour mills situated nearby are also getting their power from the Tilaiya hydro electric power station

On account of floods in this area people had left their homes Since the completion of the dam they have started coming back to reoccupy and build houses on the old sites All this has been possible at a cost of Rs 3 crore only

Konar

The Konar dam is now in the last stages of construction Its site is on the Konar river a tributary of the Damodar in the Hazaribagh district of Bihar 15 miles above its confluence with the Damodar The nearest railway station is Hazaribagh Road on the Grand Chord and Gumia on the Barkakana loop of the Eastern Railway

The work on the dam began in May 1950 It was designed by Messrs Gruner Brothers of Switzerland while its construction has been entrusted to Messrs Hind and Patel The progress was unsatisfactory at the beginning owing to the slow delivery of equipment from abroad Gradually however the tempo of building grew and a new concreting plant was installed with a total output of 12 00 cubic yards per day The dam which is nearing completion now has started storing water from November 1952 The reservoir is supplying the cooling water for the Thermal Power Plant at Bokaro

This dam will finally store 260 000 acre feet of water and the length of the backwater will be 9 river miles it will supply 400

cusecs of cooling water daily to the Bokaro Thermal Power Station generate hydro-electric power to the extent of 191 000 000 kwh per annum and supply *kharif* irrigation for 36 000 acres and *rabi* irrigation for 68 000 acres totalling 104 000 acres

Maithon

The site of the Maithon dam is on the border of Bihar and West Bengal. It is eight miles above the confluence of the Damodar and the Barakar 13 miles north west of Asansol and 25 miles east of Dhanbad This dam is designed mainly for flood control. Like the Konar it is also partly concrete and partly earthen. With the Panchet Hill dam it is one of the two key dams in the Damodar Valley

Through the left bank of the river a diversion tunnel has been made so that water may flow through it in the dry season i e from October 1952 to June 1953 Ultimately however this will serve as a tail race tunnel for the underground power station to be installed later Except for this tunnel which was designed by the Hazra Engineering Company the dam is being constructed departmentally The open cut work on the approaches and discharge ends of the tunnel was also done departmentally while a firm of contractors were responsible for the actual construction of the tunnel The tunnel is 34 feet wide 42 feet high and 1 140 feet long The designs of the main dam were prepared in India by the DVC personnel under the general supervision of a resident engineer of the Hazra Engineering Company

The main dam will be completed in two seasons The structure will consist of about five million cubic yards of earth and 450 000 cubic yards of concrete It may be mentioned in passing that the most critical period for the construction of this dam was from October 1952 to June 1953 when a diversion channel had to be cut on the right bank and the excavated material placed right across the river This channel is 350 feet wide and 4 400 feet long and it is meant to divert the flow of the river during the monsoon months in 1953 Afterwards this channel will be closed by a concrete dam and spillway The volume of earth and rock materials excavated approximates [illegible] million cubic yards All the necessary constructional equipment and trained staff both operational and supervisory had to be gathered on the spot by October 1 so that the diversional channel might be completed before

the monsoon set in Men were trained step by step in the operation of tractors shovels and other heavy earth moving equipment The trained crew of operators at the site numbered nearly 200

It is expected that the concrete spillway — with 450 000 cubic yards of concrete poured in — will be completed by July 1954 For this ambitious undertaking a concreting plant was ordered which consists of crushers screens belt conveyors batching plant and two big revolving cranes The plant will to all intents and purposes be automatic and will require a minimum number of personnel for its operation It will have a capacity of 2 000 cubic yards a day

Panchet Hill Dam

Like Maithon the Panchet Hill dam is being built primarily for flood control In design as well as size it is similar to Maithon dam It will store about 1 2 million acre feet of water and provide flood control to the extent of two thirds while the Maithon dam will provide the rest The length of the dyke is about 2½ miles It is the last of the dams to be undertaken in the first phase The construction colony the approach to the dam site the sub surface investigation preliminary designs and firm estimates have all been completed The machineries and eq ipment are at hand a competent organisation for construction work has been built up and as the work is similar to that at Maithon the experience already gathered there has been found invaluable The equipment for Maithon was so chosen that a large percentage can be utilised at Panchet Hill too It means in short the maximum use of machinery and personnel with the minimum of expenditure The work in Panchet Hill has started earth is being moved from the diver sion channel and loaders dumpers and sheep foot rollers have been at work for some time It is expected that the work will be completed before schedule at the end of 1955

Bokaro Thermal Station

The construction of a gigantic power station at Bokaro is another feat to the credit of the DVC. It was also opened by the Prime Minis ter on February 21 1953 when it started generating power

The plan was to install three 50 000 kw turbine generator units first and another 50 000 kw units afterwards As stated earlier one

of the main purposes of the thermal plant is to firm up the unstable power supply from the hydro electric plants In fact the demand for power is already so high in the valley — and its prospective demand is likely to be higher still — that it can be said that all the power supplied by Bokaro and the hydro electric stations will not be able to cope with the potential demand

Of the projected four units one has already been installed and two more are under erection In spite of many difficultie, this gigantic construction was completed in a short time In this connection plants and equipment had been ordered as early as February 25 1949 Owing to the long post war boom and the condition of full employment abroad imports were difficult long negotiations had to be carried on with foreign manufacturers for the supply of equipment while considerable difficulties were found in recruiting technical personnel All these indeed have to be weighed in order to appreciate the speed with which this project has been executed

Besides the access roads money was spent also on the construction of a colony a barrage across the Konar river to divert cooling water into the power station and an aerial ropeway about six miles long to transport coal to the power station It may be remembered that the World Bank had advanced a loan amounting to 18 5 million dollars in May 1950 to cover part of the cost of the Bokaro Power Station the Konar dam and the DVC power transmission system Recently it gave a second loan to the DVC amounting to 19 5 million dollars to cover part of the costs on Maithon and Panchet Hill dams the hydro-electric stations and the irrigation canals

The equipment was supplied by such leading manufacturers as the International General Electric Company the Combustion Engineering Superheater Incorporated and others while they have been skilfully designed and engineered by the Kuljian Corporation The Kuljian Corporation has also utilised its construction and operation experience to co-ordinate and train local personnel in building this high pressure station the first and largest in Asia.

The plant has been laid out on the unit system i e two boilers feeding a single turbine The coal will be pulverised before it is transported to the station by means of the aerial ropeway The boilers

are so designed that they can u e pulverised coal with a maximum ash content of 50% They generate steam at a pressure of 900 lb per square inch and a total temperature of 910 F whi h must be rated the highest in the country The coal utilised for this purpose is not and cannot be used for any other purpose — a fact which means that by using this low grade coal the power station will conserve high class coal the stock of which is limited

The plant ash handling system is designed to handle bottom ash at the rate of 240 tons per hour or fly ash at the rate of 60 tons per hour Although only 2 boilers have been installed the ash removal equipment is designed for 8 boilers The ash handling system is controlled from one central panel and two other small stations located in the basement

Leading from the Konar river to the bar screen structure there is an intake channel 12 000 feet long which serves as a settling basin for the water requirements of the station which amount to 250 000 gpm The divided bar screen and stop gate structure are placed at the south end of the building and they feed the intake tunnel The dis charge tunnel runs under the building for its full 450 feet length then turns and continues south-east to the discharge control structure which is 1 200 feet away The stru ture is designed to discharge water both above and below the barrage Normally the flow will be below it while during the dry season when water is scarce the discharge will be above the barrage The steam generating units are each designed to generate 300 000 lb of steam power continuously Each steam generator is equipped with four burners Two pulverisers are provided for each boiler one feeds the two lower burners and the other the two upper burners Each pulveriser is sized to carry 80% of the full load The station has been designed for pulverised coal fuel only

The main building is approximately 170 ft. by 450 ft. There are five floors from the basement. The main roof of the building is 118 feet (92 ft + 26 ft basement) above the basement floor and the four self supporting steel stacks 85 feet high are supported on steel girders The entire building is made of structural steel to sustain all loadings including the forces set up by wind and possible earthquake action The main operating floor is of reinforced concrete slab

upper floors and platforms of metal gratings are removable when required The four turbine generator foundations are of reinforced concrete and are entirely independent of the building It may be noted here that on the east wall area 50 feet high and running along the length of the building the local authorities have decided to commemorate the history of the local inhabitants in a series of murals Since the Prime Minister opened the Bokaro Thermal Power Station in February 1953 Unit No 1 has been in operation The machine is capable of gen rating between 50 000 kw and 57 500 kw which is the guaranteed maximum rating with higher hydrogen pressure but as the sub stations at Loyabad Sindri Maithon and other places are not yet completed it is only generating 20 000 kw for the present Some of these stations are however expected to be completed between October and December of 1953 The present load of elecricity is being supplied to Jharia and Raniganj coal fields the Chittaranjan Locomotive Works and the Kulti Iron Works Some power is also being drawn from here for Bokaro and Maithon The cost of this power will be a little over two pies per unit to the consumer The DVC can supply in bulk only at 132 kw 66 kw and 33 kw the actual distribution to consumers has therefore to be done by the Bihar Government or by big electric supply companies

In the initial stages of construction some Americans had to be appointed to positions of higher responsibility like those of the Chief Civil Engineer Chief Mechanical Engineer and Chief Electrical Engineer The rest of the staff were supplied by the DVC Ten Indian Engineers with previous experience were selected and sent to the USA for specialised training in power house construction and operation On their return from the States these engineers have gradually replaced the American engineers At pre ent except for the Project Manager there is no other American employed at the plant For the operation of the plant, the Technical Co-operation Administration have however sent at their cost three American engineers to work in an advisory capacity The operating engineers at the plant are all Indians

While the construction and operation of the Bokaro Power Station is admittedly a joint enterprise power transmission and distribution are entirely the work of Indian engineers in the employ of the

DVC Even before the Bokaro Station came into operation the surplus power from the Sindri Fertiliser Factory had to be fed into the DVC grid which had already been erected Today there are more than 150 route miles of transmission lines in this system while several sub-station have meanwhile been completed The organisation of the transmission section is proceeding according to schedule Except for the delay in receiving the transformers from the UK which in its turn resulted in some delay in building the sub-stations there has hardly been any set back to its progress In fact as mentioned the DVC grid is already supplying electricity to different industrial establishments It is expected that this will eventually supply power up to Calcutta and may even make it possible for the railway between Calcutta and Mughal Sarai to be electrified

Durgapur Barrage

The work on this barrage commenced late in 1952 It is expected to be completed by June 1955 when the entire system with which it is linked viz the Maithon and the Panchet Hill dams is expected to be ready While the span of the river at Durgapur is one mile the barrage will be *2 271 feet in length or about half the width of the* river and its height above the average river bed level will be 20 feet The idea is to reduce the width of the river by constructing two guide bunds on either bank in order to reduce the cost of the structure The left guide bund is already complete while the work on the right is proceeding The barrage will have 34 gates altogether of which ten will be for the under sluice bay five at each end in order to keep the entrance to the canal free from silt The remaining 24 gates will be in the actual weir bays Friction blocks or energy dissipators will be provided at the downstream end of the glacis throughout its length Though the actual work on this project started late in 1952 the digging of the canals for the extension of irrigation from the existing Damodar canal system and for the relief of the drainage congestion in the swampy areas had started a year earlier In the meantime the work has made satisfactory progress A huge army of labourers—about 30 000 in all—armed with giant machines like concrete mixers and cranes have been working incessantly The working area is kept dry by dewatering pumps which have been working day and night for the past six months pumping out water at the rate of 15 to

20 cubic feet per second At the same time tractors bulldozers dumpers loaders and excavators have been busy and canals and distributaries have been dug over more than 150 miles Clearly the method of work here is a judicious mixture of manual labour and mechanical device

The purpose of the Durgapur barrage is to utilise the water from the projects upstream for irrigation Out of its extensive canal system extending over 1 563 miles the main canal on the left bank will be a navigation canal for 85 miles connecting Calcutta with the coal fields The digging of this as well as the other canals and distributaries is under way and the whole system is scheduled to be completed by June 1957 although water for irrigation in the main canal will be available from 1955 onwards It should be remembered that with its completion these canals will command an area of 1 025 762 acres for irrigation

The Durgapur project has been designed and constructed by Indians As at all other dam sites and at the Thermal Power Station a colony consisting of about 400 quarters has grown up for the staff Meanwhile the construction activities have developed the countryside and given it six modern townships containing more than 2 000 buildings — Bokaro Maithon Durgapur and three others Although the colony was started only a few months ago all modern amenities are already available at Durgapur Houses hospitals roads shops schools and electricity are all at the disposal of these towns In addition the DVC has built 11 bridges and 160 culverts as well as 100 miles of first class roads in those parts of the valley which were least accessible It has given employment to more than 40 000 hands reclaimed 6 000 acres of badly eroded land and brought to the valley the benefits of the modern system of medicine hitherto practically unknown to it As time passes the work of the DVC gathers momentum for the preliminary hurdles and obstacles have now been overcome Already the valley is reaping the fruits of the new enterprise In less than two years the face of the whole area will be changed beyond recognition As the Prime Minister said in his inaugural speech at Tilaiya and Bokaro A new India is being born in the valley It is the India of our dream

CHAPTER VII

OTHER BENEFITS

Medical

The activities of the DVC s Medical Department extend all over the colonies set up by it as also to the sites of work There are the dispensaries and hospitals the doctors compounders and medical assistants the malaria inspectors vaccinators and inoculators doing their daily round of work The total attendance in these dispensaries swelled from 37 399 in 1949 50 to 2 27 321 in 1952 53 but perhaps the most important work of the Medical Department concerns the measures undertaken by it to fight malaria and to control its incidence Extensive surveys have been made and the control measures adopted extend beyond the camp areas of Tilaiya Konar Bokaro Maithon Panchet Hill and Durgapur While construction activiti s are in progress inevitably breeding areas are created for mosquitoes These places are extensively treated with Malariol B throughout the year thereby combating the mosquito nuisance successfully Permanent drains for house water torm water and the effluent from the septic tanks are under construction DDT is systematically sprayed in all houses in the camps and also in the villages within half a mile of them Malariol B is sprayed over the pools in the river bed the edges of the river drains streams tanks seepages and swamps during the malaria season between June and November In fact every type of breeding place for mosquitoes throughout the area is sprayed with DDT Paludrine tablets are used in some places as prophylactic anti malaria pamphlets are distributed and propaganda tours undertaken by the staff In special circumstances mosquito bombs are also used The re e voirs at Tilaiya Konar and Bokaro have been kept under ob er ation and a systematic collection of adult larvae is regularly mad from the areas As far as possible timber has been removed from the Konar and Tilaiya reservoirs and as permanent measures borrow pits have been filled up and *kutcha* drains made In 1952 53 2,400 cubic feet of borrow pits we e fill d in Tilaiya while 4 000 cubic feet of borrow pits were filled and 3 607 feet of *kutcha* drain

necessary fertility level Crops are also grown for purposes of demons tration to the villagers Of the 6 000 acres reclaimed about 3 700 acres have already been improved

Rehabilitation

The total area submerged and to be submerged in the process of executing the first phase of the project amounts to 83 379 acres of which the total culturable land is roughly 46 500 acres and the culturable waste about 3 540 acres The total number of houses submerged and to be submerged is 5 107 and the number of people affected is 31 638 The latter were promised land for land and house for house while those who preferred cash could get cash payment instead This has been the principle formulated by the DVC In the case of the Tilaiya dam 629 houses were affected and 275 houses had to be replaced according to the choice of the displaced people Actually 343 houses have been built and transferred to the families who have opted for new houses instead of cash The discre pancy between the total number of such house and the total number of houses built is explained by the fact that more than one family used to live in some of the old houses The number of houses built is therefore greater than the number of those to be replaced Those who preferred cash have received cash As regards land 4 495 acres have been reclaimed for Tilaiya and given to displaced people according to their wishes Similarly reclaimed land is being given to displaced people at Konar The total number of houses to be replaced according to options exercised by displaced persons is 60 and the houses have been built by the villagers themselves The rest have accepted cash payment In Bokaro 59 houses were affected and as in Konar the displaced people have built the new houses themselves The compensation of land for land was also given to those displaced from Bokaro It was estimated that the number of houses affected at Maithon would be 1 650 Here too house for house or cash compensation will be given as elsewhere The total area for which option has been received is 500 acres of which more than 360 acres have already been reclaimed In Panchet Hill it is estimated that 2 630 houses will be affected while the area of total culturable land will be 16 853 acres The people s choice in regard to the method of compensation has not yet been indicated In the case of land the principle is to give plots not equal in size but

equal in yield The newly reclaimed land has been treated scientifically and all precautions against soil erosion and loss of fertility have been taken and the recipients taught to follow them

The displacement of people in the reservoir areas is pre planned and arranged in stages as each reservoir fills Accordingly the displaced are settled and rehabilitated just as the reservoir starts to fill The policy has been to give the people better houses better land and more important still a better way of living To this end attempts have been made to obtain an authentic picture of the social and economic aspects of the life of the people Data have been obtained regarding the major and secondary professions of the population their literacy their incomes in foodgrains and cash the number of cattle owned by them and their professional option in regard to compensation *as to whether they would accept cash or house for house and land* for land compensation The census undertaken in this matter has been completed for more than 4 000 families living in the areas already submerged or to be submerged by the dams and the thermal plant Ground plans for 2 519 houses with detailed specifications have been drawn up and an authentic record of rural housing obtained for this area This has facilitated the laying of type designs for better housing Altogether four new villages have been constructed to date They have been planned and constructed scientifically with the necessary forests and pastures Adequate roads open spaces and community centres have been provided for Open air schools as at Santiniketan have been started and considering the circumstances the attendance has been encouraging Houses have been built separately while useful and decorative trees have been planted on both sides of the road as wind breaks All the trees for planting are grown in the central nursery at Hazaribagh The order of neighbourhood of the old villages is maintained as far as possible An adequate number of *pucca* wells have meanwhile been constructed for the water supply When electricity comes it is proposed to have an overhead tank and taps near the wells and enclosed spaces for bathing and washing Small ponds have also been dug as part of reclamation

In planning and building houses the aim was to make them commodious comfortable and acceptable to the people and to use locally available building materials Indeed the newly built

for the displaced people have raised the standard of housing in the valley considerably Four types of such houses have been built on plots of 1146 826 530 and 300 sq ft respectively In addition a few extra sizes have also been made for the owners of very large houses It has been mentioned that the lands given to the displaced people are reclaimed waste land and the DVC has b en giving them all aid to grow crops scientifically and in plenty The peasants are thus helped not only to improve the output but also to introduce double cropping It has been noticed that contour terracing has substantially increased the capacity of the soil to retain water Green and artificial manures are being increasingly used and encouraged by results the cultivators are buying quantities of nitrogenous and phosphatic manures from the DVC which runs demonstration farms near each rehabilitation colony

Although the displaced people are mainly agriculturists the provision of supplementary industries to fit in with their agricultural vo ation has not been neglected Bamboo agave and sabai grass will be grown in the forests and cottage industries will be developed with these raw materials Particular care is being taken to introduce better ways of living on a co-operative basis to suit the needs of these people

Are the displaced people happy in their new surroundings ? To a question of this kind the reply given by an old headman is rather touching Tokan Mahato for that is the name of this nature s philosopher said *I* can never be happy —I have lost the house of my ancestors and I won t get it back But never mind me think of my children they will be happy and by God their children after them